Witzkeite: A new rare nitrate-sulphate mineral from a guano deposit at Punta de Lobos, Chile

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ABSTRACT

Witzkeite, ideally Na,K,Ca(NO3)2(SO4)2·2H2O, is a new mineral found in the oxidation zone of the guano mining field at Punta de Lobos, Tarapacă region, Chile. It occurs as colorless, tabular crystals up to 140 μm in length, associated with dittmarite and nitratine. Witzkeite is colorless and transparent, with a white streak and a vitreous luster. It is brittle, with Mohs hardness 2 and distinct cleavage on {001}. Measured density is 2.40(2) g/cm³, calculated density is 2.403 g/cm³. Witzkeite is biaxial (−) with refractive indexes α = 1.470(5), β = 1.495(5), γ = 1.510(5), measured 2V = 50–70°. The empirical composition is (electron microprobe, mean of five analyses, H2O = 3.95, total 100.64; CO2 = 1.93, total 100.47). Witzkeite is monoclinic, space group C2/c, with unit-cell parameters: a = 24.902(2), b = 5.3323(4), c = 17.246(1) Å, α = 94.281(7)°, β = 94.281(7)°, γ = 94.281(7)°. Witzkeite was collected in the range 390–4000 cm⁻¹. The IR spectrum is discussed in detail.

Keywords: Witzkeite, new mineral, guano, crystal structure, sulfate, nitrate, IR spectroscopy

INTRODUCTION

Minerals simultaneously containing sulfate and nitrate groups as species-defining components are extremely rare. Only three such mineral species were previously known: darapskite, Na₄(SO₄)(NO₃)·3H₂O, space group P2₁/m (Sabella 1967), engemachite, K₃NaFe³⁺(SO₄)₂(NO₃)₂·6H₂O, space group R3 (Groat and Hawthorne 1986) and humberstonite, K₃Na-Mg₃(SO₄)₂(NO₃)₂·6H₂O, space group R3̅ (Burns and Hawthorne 1994). Engemachite and humberstonite are structurally similar to one another, whereas darapskite has a markedly different structural arrangement. These minerals all have similar origin and provenance as they are found in sulfate and nitrate deposits situated in Chile (even if in different regions), all occurring in areas with very arid climates.

The new mineral witzkeite, the fourth sulfate-nitrate compound discovered in nature, is characterized by a new crystal structure type. It was found in the oxidation zone of an outcrop 1 x 1 m² in size located in a guano mining area (400 x 200 m across) on the southeast slope of Punta de Lobos, Tarapacá region (Chile), approximately 90 km south of Iquique (21°12'S 70°05'W). Witzkeite appears to be extremely rare as only two small samples have been found.

Witzkeite has been approved by the Commission on New Minerals, Nomenclature and Classification, IMA no. 2011-084. Holotype material is deposited in the mineralogical collection of the Museum of Mineralogy of the Department of Geosciences at the University of Padova (Italy), under catalog number MMP M10009. The name is in honor of Thomas Witzke (b. 1963), a well-known German mineralologist whose study of alteration processes and products has resulted in the discovery and description of several new minerals.

APPEARANCE, MINERAL ASSOCIATION, PHYSICAL AND OPTICAL PROPERTIES

Witzkeite forms elongated, tabular crystals up to 140 μm in length (Fig. 1) and is associated with dittmarite and nitratine. It is colorless and transparent, with a white streak and a vitreous lustre. Witzkeite is brittle, with Mohs hardness 2 and distinct cleavage on {001}. No parting is observed and fracture is uneven. Twinning was not observed. Witzkeite dissolves in water (slowly...